Astronomy and Astrophysics 2016 vol.594

Planck 2015 results: XXI. The integrated Sachs-Wolfe effect

Ade P., Aghanim N., Arnaud M., Ashdown M., Aumont J., Baccigalupi C., Banday A., Barreiro R., Bartolo N., Basak S., Battaner E., Benabed K., Benoît A., Benoit-Lévy A., Bernard J., Bersanelli M., Bielewicz P., Bock J., Bonaldi A., Bonavera L., Bond J., Borrill J., Bouchet F., Bucher M., Burigana C., Butler R., Calabrese E., Cardoso J., Casaponsa B., Catalano A., Challinor A., Chamballu A., Chiang H., Christensen P., Church S., Clements D., Colombi S., Colombo L., Combet C., Couchot F., Coulais A., Crill B., Curto A., Cuttaia F., Danese L., Davies R., Davis R., De Bernardis P., De Rosa A., De Zotti G., Delabrouille J., Désert F., Diego J., Dole H., Donzelli S., Doré O., Douspis M., Ducout A., Dupac X., Efstathiou G., Elsner F., Enßlin T., Eriksen H., Fergusson J.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© 2016 ESO.This paper presents a study of the integrated Sachs-Wolfe (ISW) effect from the Planck 2015 temperature and polarization data release. This secondary cosmic microwave background (CMB) anisotropy caused by the large-scale time-evolving gravitational potential is probed from different perspectives. The CMB is cross-correlated with different large-scale structure (LSS) tracers: radio sources from the NVSS catalogue; galaxies from the optical SDSS and the infrared WISE surveys; and the Planck 2015 convergence lensing map. The joint cross-correlation of the CMB with the tracers yields a detection at 4σ where most of the signal-to-noise is due to the Planck lensing and the NVSS radio catalogue. In fact, the ISW effect is detected from the Planck data only at â‰ 3σ (through the ISW-lensing bispectrum), which is similar to the detection level achieved by combining the cross-correlation signal coming from all the galaxy catalogues mentioned above. We study the ability of the ISW effect to place constraints on the dark-energy parameters; in particular, we show that ΩΛ is detected at more than 3σ. This cross-correlation analysis is performed only with the Planck temperature data, since the polarization scales available in the 2015 release do not permit significant improvement of the CMB-LSS cross-correlation detectability. Nevertheless, the Planck polarization data are used to study the anomalously large ISW signal previously reported through the aperture photometry on stacked CMB features at the locations of known superclusters and supervoids, which is in conflict with ΛCDM expectations. We find that the current Planck polarization data do not exclude that this signal could be caused by the ISW effect. In addition, the stacking of the Planck lensing map on the locations of superstructures exhibits a positive cross-correlation with these large-scale structures. Finally, we have improved our previous reconstruction of the ISW temperature fluctuations by combining the information encoded in all the previously mentioned LSS tracers. In particular, we construct a map of the ISW secondary anisotropies and the corresponding uncertainties map, obtained from simulations. We also explore the reconstruction of the ISW anisotropies caused by the large-scale structure traced by the 2MASS Photometric Redshift Survey (2MPZ) by directly inverting the density field into the gravitational potential field.

http://dx.doi.org/10.1051/0004-6361/201525831

Keywords

Cosmic background radiation, Cosmology: observations, Dark energy, Galaxies: clusters: general, Large-scale structure of Universe, Methods: data analysis